

1868.

1886.

IRON HIGHWAY BRIDGES,

AS BUILT BY THE

PENN BRIDGE COMPANY,

BEAVER FALLS,

PA.

J. W. SHIPMAN,

Eastern Agent,

59 TRIBUNE BUILDING,

NEW YORK.

A faint, out-of-focus background image of a bridge with multiple arches and a road surface.

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THE PENN BRIDGE COMPANY.

Beaver Falls, Pa.

ENGINEERS AND MANUFACTURERS,

CONTRACT FOR

WROUGHT IRON, STEEL AND COMBINATION BRIDGES,

IRON SUB-STRUCTURES,

Buildings, Roof Trusses, Plate, Box and Lattice Girders,

AND

ARCHITECTURAL IRON WORK GENERALLY.

To THE PUBLIC.

WE wish to extend our thanks to our friends and patrons for the cordial welcome which was extended to the first edition of our illustrated pamphlet. Some additional illustrations have been added in this edition, which will, we trust, make it of still more interest to you. We wish to add something to the general fund of information possessed by those who have charge of the letting of Bridge Contracts, and to aid them in instituting a fair comparison between different plans submitted, so that those which have the greatest merit, if presented by a Company having a good reputation for fair dealing and good, honest work, may have the preference to which they should be entitled. We make no claim that we are the only Bridge Company that can or does do good work; but we feel confident that our many patrons will bear us out in the statement that we always endeavor to faithfully perform our contracts, and to keep in the front in the march of improvement. Few persons realize how vast has been the improvement in Iron Bridge construction; how much of it has been accomplished within a comparatively short period, and how long is the list of names of the pioneers and promoters of this great industry. It may not be amiss, in this connection, to append a brief sketch, giving a few points, some of which may be new to our readers.

IRON BRIDGE CONSTRUCTION.

The earliest bridge, in the construction of which iron formed the principal part, was, if we may believe Kirchen, in his "China Illustrated," a product of the civilization of the great Oriental Empire in the days of antiquity, prior to the Christian Era, in the form of a Suspension Bridge composed of chains, on which the floor was directly laid, following, consequently, the curvature of the suspended chains.

We have no further record of the use of iron in bridge construction until a long time afterward, about the close of the last century, when cast iron was employed, instead of stone, in the construction of an arch bridge of one hundred feet span, at Colebrookdale, England. It has, however, remained for the present century to develop the highly perfected forms of wrought iron and steel bridges which we now have. Of these, the enormously heavy tubular bridges across Menai Strait and the St. Lawrence are amongst the principal precursors, on the one hand as to the material, and the simple skeleton structures of Whipple, on the other hand as to the type, to which the more elastic and trustworthy material has been adapted, replacing the crude unreliable cast iron which so largely entered into the earlier bridges of this form. Post, Fink, Warren, Bollman and others introduced various forms of skeleton structures as distinguished from the solid tubular girders and heavy lattice trusses; and these all have been modified in form and improved on in details by Latrobe, Murphy, Linville, C. Shaler Smith, Cofrode, Wilson, and like ingenious men; while Wood, Shreve, Merriman and Burr, have, through complete and elaborate investigations, placed such formulas in the hands of the engineer as to enable him to dispense with much of the drudgery and tedious courses of experiments on models, &c., which the earlier builders had to go through with, and to entirely do away with the "rule of thumb" methods which were much in vogue among a certain class of highway bridge builders some fifteen or twenty years ago. We have said nothing of the development of suspension bridges by Ellet and the illustrious Roebling, which has its greatest achievement in the Brooklyn Bridge; as it is a peculiar and special type which has been shown to be only desirable in such long spans as are as yet unusual in framed structures. A good illustration of this type, as designed and built by our Mr. Shipman, is however, shown on page 24. The Niagara Cantilever Bridge bids fair to be the forerunner of a formidable competitor to suspension bridges for long spans. Our wish is now, however, to trace out simply the development of that class of bridges which is a universal want of the civilized world for the common roads and highways of the people. Among the first iron highway bridges in this country were the cast iron bow-string, commonly called arch, truss bridges, built by Whipple in eastern and central New York. The arches were cast in straight segments of a circle, increasing in width from the center or top of the arch, to the skewback or base; they were very heavy, thereby making a well-braced, solid structure; the lower chord, or string of the bow, was made of long links of round iron formed just as the links of a chain are made, but of lengths equal to that of the panels of the bridge; these were connected by oval shaped cast iron bars or pins. Mr. Whipple also built a number of truss bridges of the type known by his name, with cast iron upper chord and posts. These bridges, however, were expensive, and in the country west of New York scarcely known and could hardly compete with such bridges as were built there of wood. This set the inventive genius of the western country to work; and some twenty or twenty-five years ago several styles of tubular arch or bow-string bridges were introduced, at such prices as to induce highway authorities to give them a trial: almost all these bridges, however, were built simply

to sell, and although the materials from which they were made were of sufficient size so that they answered the purpose of a bridge in most cases for a time, especially in short spans: yet they were generally constructed with so little regard to the principles of correct bridge construction that there have been many failures of these bridges and their earlier competitors and successors. About 1866, Mr. T. B. White, the founder of our firm, an experienced builder of wooden bridges of the Howe and Burr truss styles, on the earlier railroads of western Pennsylvania and Ohio, foreseeing that iron was destined to be the material of which the bridge of the future was to be built, endeavored to elevate the standard of highway bridge construction, and introduced the Whipple style of bow-string bridges, soon adapting, also, wrought iron to the arch members of the same; and there is no doubt that these are among the best bridges now remaining of that class of structures; he also, knowing the acknowledged pre-eminence of the Howe truss among wooden bridges, attempted to introduce it in iron as well; but it did not prove to be an economical design in iron when compared to the Whipple truss and was soon abandoned, although a number of spans of about one hundred feet each are still in permanent use and mark the progress of the science. It should always be remembered, however, that the correct principles of bridge construction were but little known or understood at this time, and that "rule of thumb" methods were the rule and not the exception. Soon, however, influenced, no doubt by the fact that the active minds of men who had been engaged in strife during the late war, were now diverted into peaceful channels, there were immense strides taken in the development of correct mathematical principles governing bridge construction, not only in general principles but also in those governing the minutest details of construction; and so far has this progressed in the past twelve or fifteen years, that it may now be said that, with the majority of builders, more attention is paid and more skill displayed than in almost any other branch of mechanical construction; and this is the case, not only in railroad bridges, where we would naturally expect to see it, because of the intelligent supervision of their chief engineers and other officers, but competition has also made it progress fully as far in highway bridge construction. For the benefit of those, however, who are called upon to have charge of bridge work without the preparation or technical knowledge which belong to the engineering branch of the profession, it may be well to enunciate a few facts and lay down a few sound principles which they may follow.

The first thing to be considered in the building of a bridge at a given point, is the number and length of the spans; here enter in the questions of economy in first cost, and also that of *safety* to the whole structure by having the water way so little obstructed by the number of piers, that there shall be as little tendency as possible to form ice-gorges, or to afford lodging places for drift, which, by pounding or by sheer force of their weight, and the pressure of the water, may endanger the masonry. All masonry, also, should be, where possible, of large stone, well bonded together and thoroughly united by good cement, and placed on a sure foundation. Where such a sub-structure is not available, the fewer the number of piers the better. To aid in

ascertaining what length of span is the most economical, when *safe*, the following statement may be made: Supposing that for a long structure no span less than eighty feet would likely ever be adopted; then if such a span, eighty feet long, would cost, say \$18 per foot; for other spans the cost would be about in the following proportion:

Span.	Cost per Lineal Foot.	Span.	Cost per Lineal Foot.	Span.	Cost per Lineal Foot.
80 feet.	\$18.00	140 feet.	\$25.00	200 feet.	\$35.00
100 "	20.00	160 "	28.00	225 "	37.50
120 "	22.50	180 "	31.00	250 "	40.00

Knowing, then, the amount of masonry required for each different number of spans which may be suggested, the cost per yard, and the probable cost of foundations, all of which can be easily estimated by any one who has ever had anything to do with charge of masonry, the most economical length of span may be figured out for any locality by the use of this table; this being determined upon, the width of roadway is the next consideration; twelve feet in the clear between trusses, gives barely enough space for the widest loads usually carried on wheels; and where room for pedestrians or horsemen to pass such loads is desired, fourteen or sixteen feet may be adopted for a single roadway, usually so termed; for a double roadway, admitting the passage of vehicles in opposite directions, eighteen feet will answer for ordinary, and twenty-four feet for the widest loads. For sidewalks, at least four feet should be allowed for the passage of two persons in opposite directions, and for constant traffic, from six to eight feet should be allowed that no one may be incommoded. In cities or large towns, it is often desirable (motives of economy only, in general, preventing) to build bridges the full width of the street: when the location of such bridges will allow of their being of the deck pattern it will usually be found economical that the trusses should be placed from sixteen to twenty feet apart, with overhanging sidewalks. Another point should be considered in fixing the width of roadways, namely, the lateral stiffness; for although bridges may be made sufficiently strong to resist any wind pressure, having long span and narrow roadways; yet for this consideration we should advise that bridges of different lengths of span should have roadways not less than given in accompanying table.

Span.	Roadway.
up to 150'	12 feet.
140 to 200'	14 "
200 to 250'	16 "
250 to 300'	18 "

Next comes the determination of the strength required. As a general rule bridges which are not likely to be subjected to frequent heavy loading may be lighter than those subjected to constant or even frequent crossing; and bridges, which, by reason of constant crossing, are likely to be at times nearly, or quite covered with loaded vehicles or large droves of cattle, should be required to be stronger than those which are never likely to have more than a few head of cattle or two or three teams on them at any one time. For these and like reasons we have made the divisions into classes which are shown in the table of required strength on the seventh page. The use of this table, it should be remembered, must be governed by the judgment of the person using it. Local conditions might require for instance, that a bridge, which the heading of the first-class would

properly describe, should be made of the strength given under the second, or even third class. We only mean to give a basis which may be assumed as the minimum strength which should be required for bridges of certain general classes.

There are certain points in most bridges which are subjected to larger concentrated loads than those given by the table would indicate; these are, the floor system—joist, beams and beam hangers, vertical suspenders, counter bracing and center posts; all these should be proportioned for as heavy a concentrated or local load as can be ascertained as used or likely to be used in the vicinity. Among the heaviest pieces of machinery likely to be taken over any bridge are the road engines in use in some parts of the country, which have a weight of eight tons on a wheel base of about eight feet by five. On roads where circuses pass the weight of the largest elephant may be a point to be taken into consideration; their weights should be taken—with allowance for impact—at six tons; the distance between the fore and hind feet being about eight feet, from which the load on any beam may be determined, and the proportion of the load may safely be assumed as in the exact center of beam or roadway.

For bridges in cities where Aveling & Porter steam road rollers are used, their concentrated weight should be provided for: the weight on front axles is about 14,000 lbs. in a width of fifty inches; the hind axle (the axles are about eleven feet on centers) supports a weight of 22,000 lbs.; wheels six feet, center to center.

In addition there may be a few points mentioned which should also be borne in mind as important ones in the selection and construction of a bridge.

1st. The greater the capacity and consequent dead load of the bridge, the less will be the effect produced on it by a rapidly moving load. In other words, a heavy bridge is stiffer than a light one.

2nd. It is important that all parts should be properly proportioned to meet the exact strains calculated to come upon them; for even if one or more members may have for example ten per cent. excess of material over that required, yet if any one member has a deficiency of five per cent., the whole bridge might as well be deficient five per cent. as far as the carrying power is concerned. A bridge is no stronger than its weakest member.

3rd. The quality of the iron should be well looked after. A good bridge iron will stand from 45,000 to 50,000 lbs. per square inch ultimate strength; 24,000 to 26,000 lbs. elastic limit; and will have a good fiber and can be bent cold from 90° to 180° without fracture.

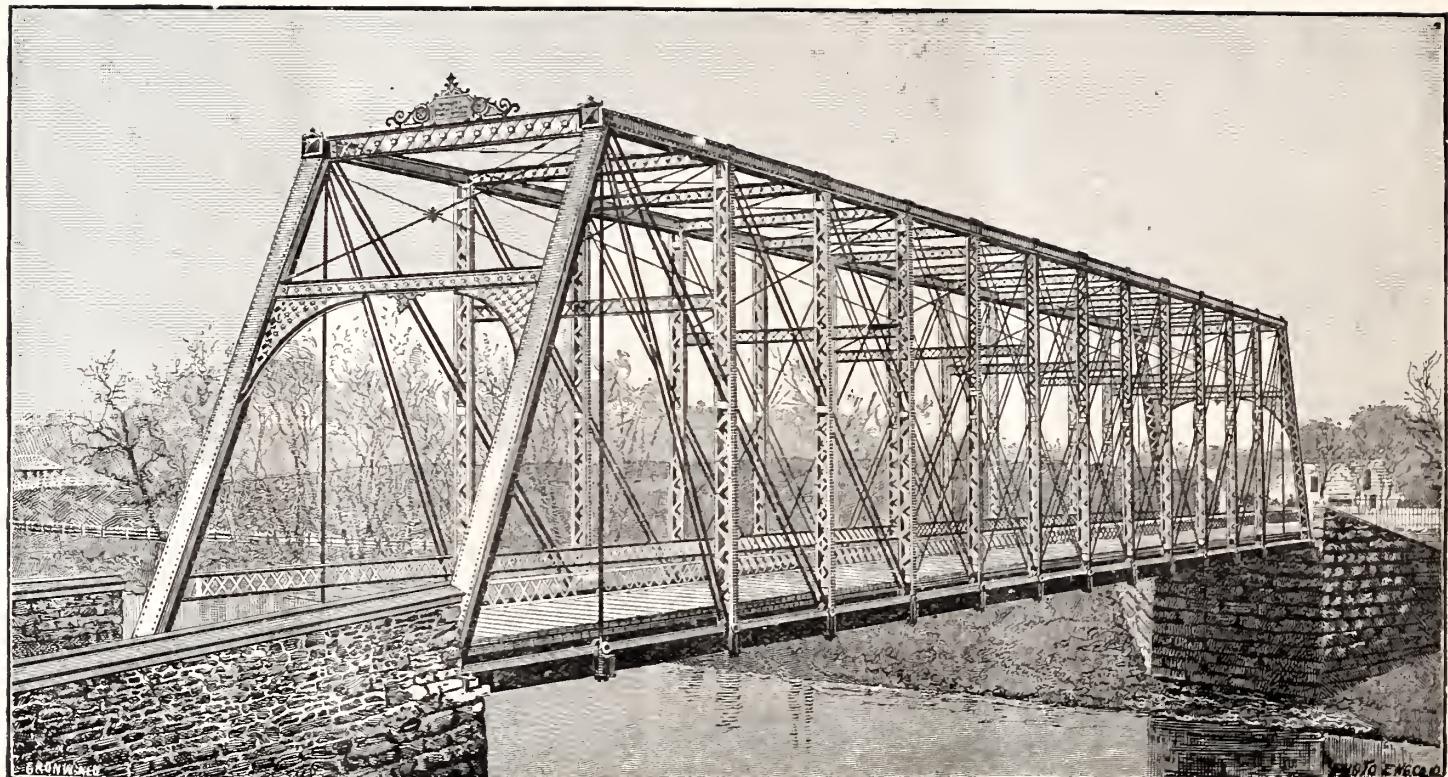
4th. The details; as the riveted connections, the bearings of pins, rivets and stirrups; the size of the pins as determined in relation to their greatest bending moment, the lateral connections, the proper painting of the iron and protection of machined surfaces before erection, are all points which can only be secured by the minutest specifications and the constant care of an expert inspector, or else by the sedulous care of a company which exercises a jealous regard of its own reputation.

5th. It is often the case that proper care is not taken of bridges after erection; they should be examined occasionally to see that dirt has not accumulated around the ends of trusses: where there are any nuts in use they should be kept tight, and the iron work painted sufficiently often to prevent rust.

Table Showing Live Load in Pounds per Square Foot of Roadway.

LENGTH OF SPANS.	Country Bridges not on Main Roads.				Bridges in Towns, or Principal Roads in Country Between Towns								Bridges in Large Towns or Cities.								Bridges on Main Streets in Largest Cities.		
	ROADWAY.				ROADWAY.								ROADWAY.								ANY ROADWAY.		
	12'	14'	16'	18'	12'	14'	16'	18'	20'	22'	24'	16'	18'	20'	24'	30'	40'	60'					
Under 60'	100	100	100	100	125	125	110	110	100	100	100	150	150	150	150	125	125	125			150		
60' to 100'	100	100	90	90	110	110	100	100	100	90	90	125	125	125	125	125	100	100			150		
100' to 125'	100	90	80	80	100	100	100	90	90	85	85	125	125	125	125	125	100	100			125		
125' to 150'	90	85	75	75	100	100	90	80	80	75	75	125	125	125	110	110	100	90			125		
150' to 175'	85	80	75	70		90	80	75	75	70	65	110	110	110	100	100	90	80			125		
175' to 200'	75	70	65			75	70	70	65	60		110	110	100	90	80	80	80			125		
200' to 250'		60	55				65	65	60	55			100	90	80	70	70					100	
250' to 300'			50				55	50	45	45				80	80	70	60	60					100
Over 300'								45	40	40					70	60	50	50					100

With these loads the proper allowable strains on iron are: For principal tension members: 12,500 lbs. per square inch; counters and suspenders—10,000 lbs. per square inch; floor beam hangers—9,000 lbs. per square inch; compression members—10,000 lbs. per square inch; reduced by Gordon's or Rankin's formulas. The load on sidewalks may be taken from 40 to 100 lbs. per square foot, according to amount of travel.



BRIDGE IN BERKS CO., PA.—200 Foot Span, 18 Foot Roadway.
BUILT BY THE PENN BRIDGE CO.

THREE QUARTER DECK BRIDGE, BEAVER FALLS, PA.

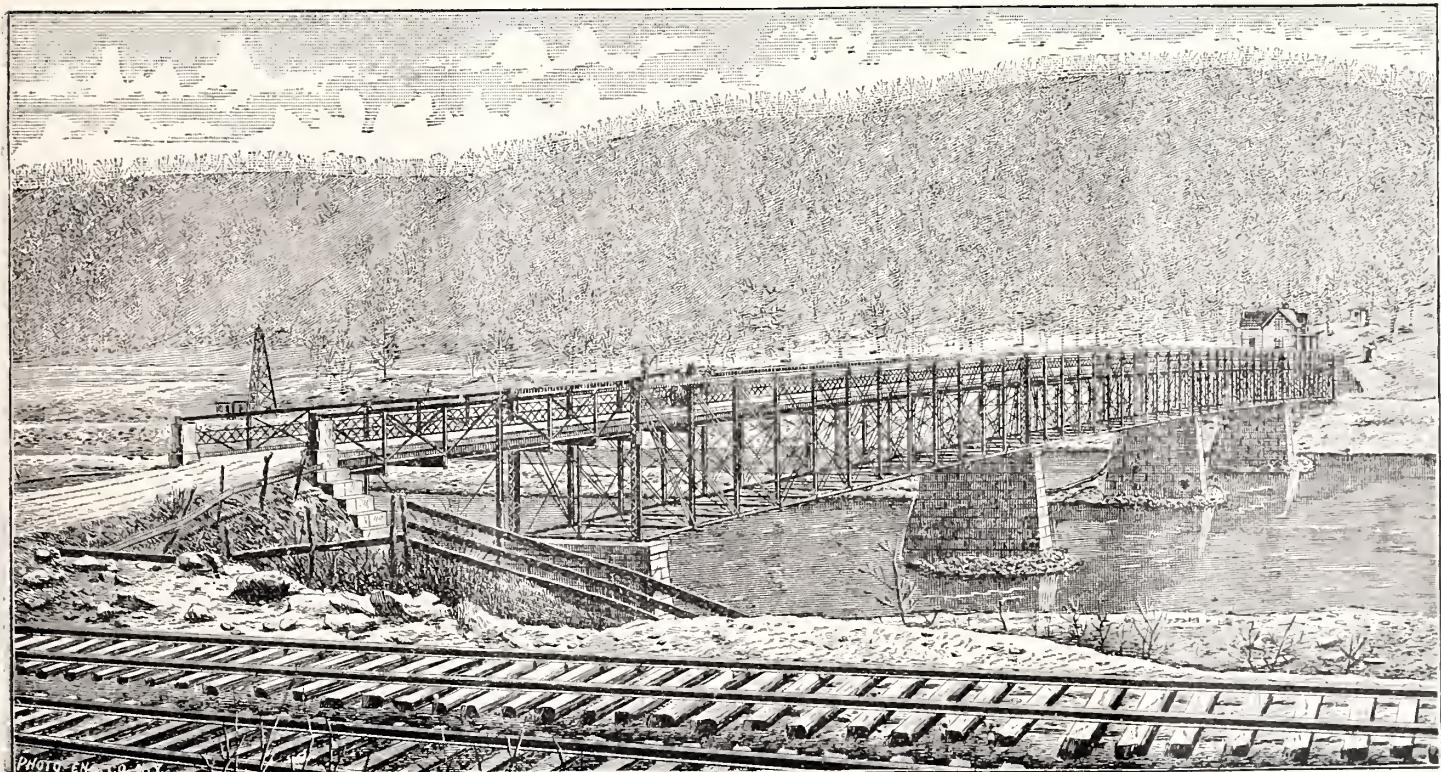


PHOTO EN. CO. NY.

FOUR SPANS, 155 FEET EACH, 20 FOOT ROADWAY.
BUILT BY THE PENN BRIDGE CO.

DOUBLE INTERSECTION, WHIPPLE OR LINVILLE TRUSS BRIDGES.

On page 8 is a good illustration of a Double Intersection, Whipple or Linville Truss Bridge. These bridges we erect for spans of 140 feet and over. In addition to the span shown we would mention the following as a few of the many of this type which we have built.

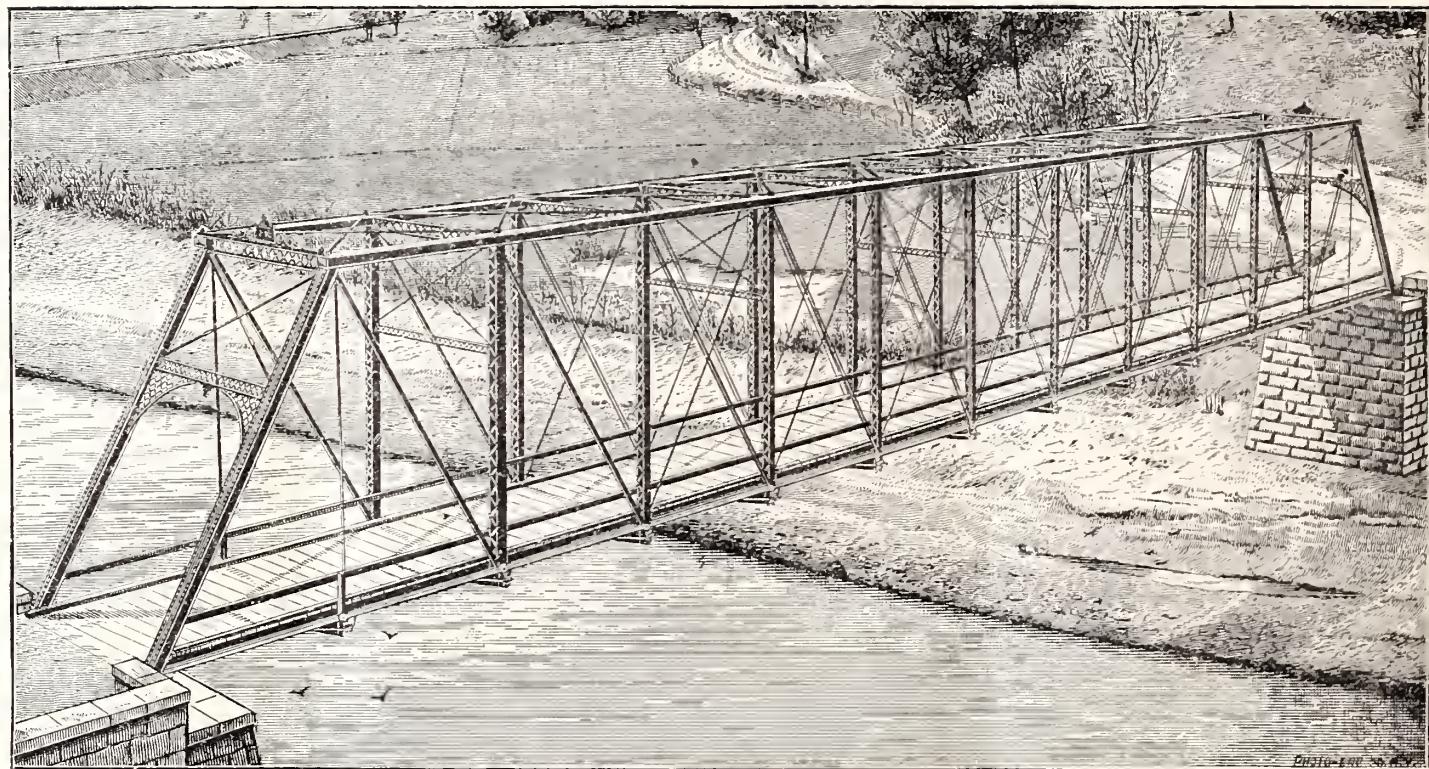
Baltimore County, Maryland.	One Span, 205 feet: roadway, 20 feet.
Frederick County, Maryland.	One " 125 " " 14 "
New Brighton, Pennsylvania.	Two Spans, 200 " " 20 " and one 5 foot walk.
Franklin County, Pennsylvania.	One Span, 120 " " 16 "
Allegheny County, Pennsylvania.	One " 125 " " 17 "
Warren County, Ohio.	Two " 150 " " 16 "
Sandusky County, Ohio.	One Span, 140 " " 18 "
Lake County, Ohio.	One " 160 " " 16 "
Fayette County, Ohio.	One " 110 " " 18 "
Lawrence County, Ohio.	One " 132 " " 16 "
Essex County, New York.	One " 150 " " 14 "
Panola County, Mississippi.	One " 160 " " 16 "
Kewaskum, Wisconsin.	One " 130 " " 16 "
Galt, Illinois.	Two Spans, 140 " " 16 "
Tyler County, West Virginia.	One " 140 " " 16 "
Culpepper and Fauquier Cos., Va.	One " 150 " " 12 "

On page 9 is shown a peculiar type of bridge, styled three quarter deck, the floor being raised in the truss, or rather the truss put mostly below floor for the purpose of saving masonry.

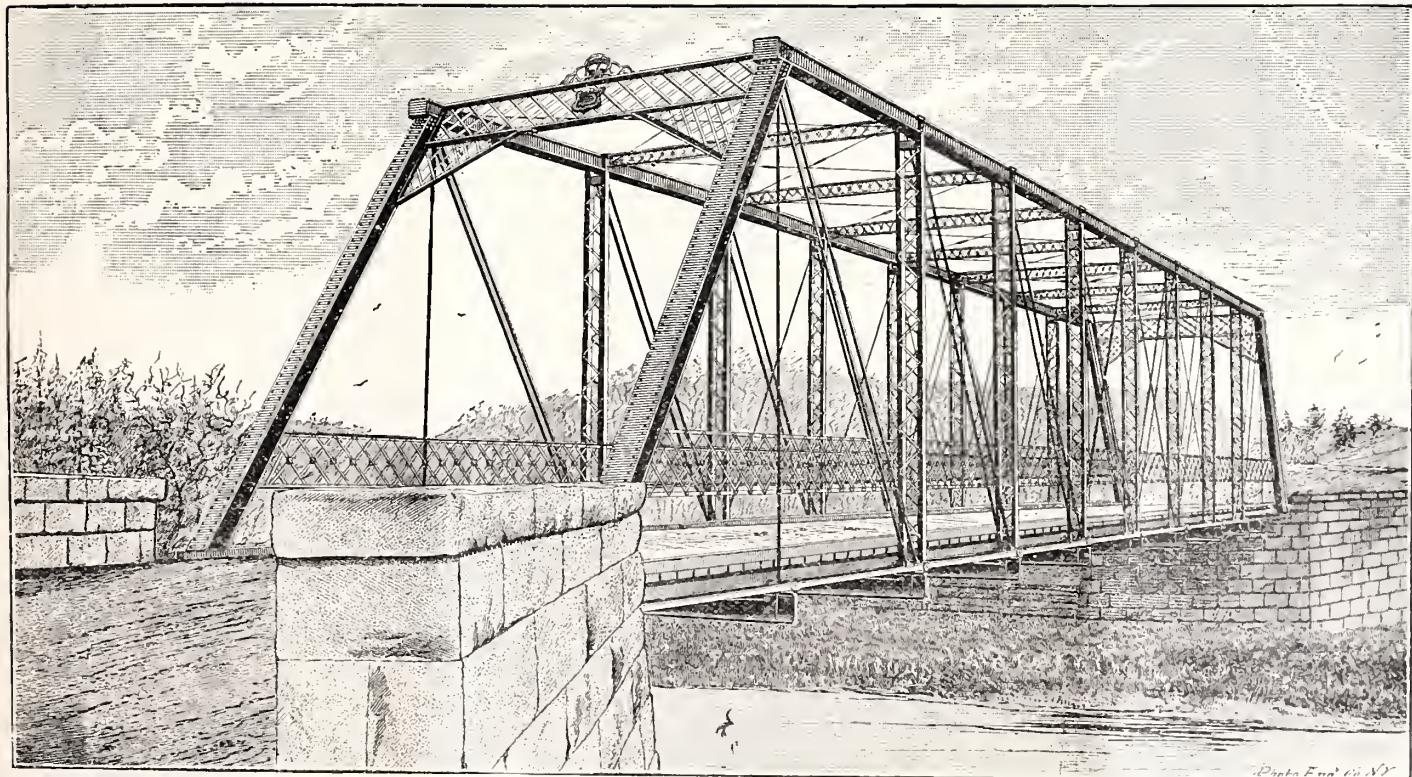
SINGLE INTERSECTION, WHIPPLE OR PRATT HIGH TRUSS.

The cuts on opposite pages 12 and 13 represent Single Intersection, Whipple or Pratt High Trusses. These bridges are adapted to spans of from eighty to two hundred feet, and are likely used more than any other style of Truss. In addition to the bridges at the locations shown in the engravings, we would name the following points as a portion of the many where we have erected this style:

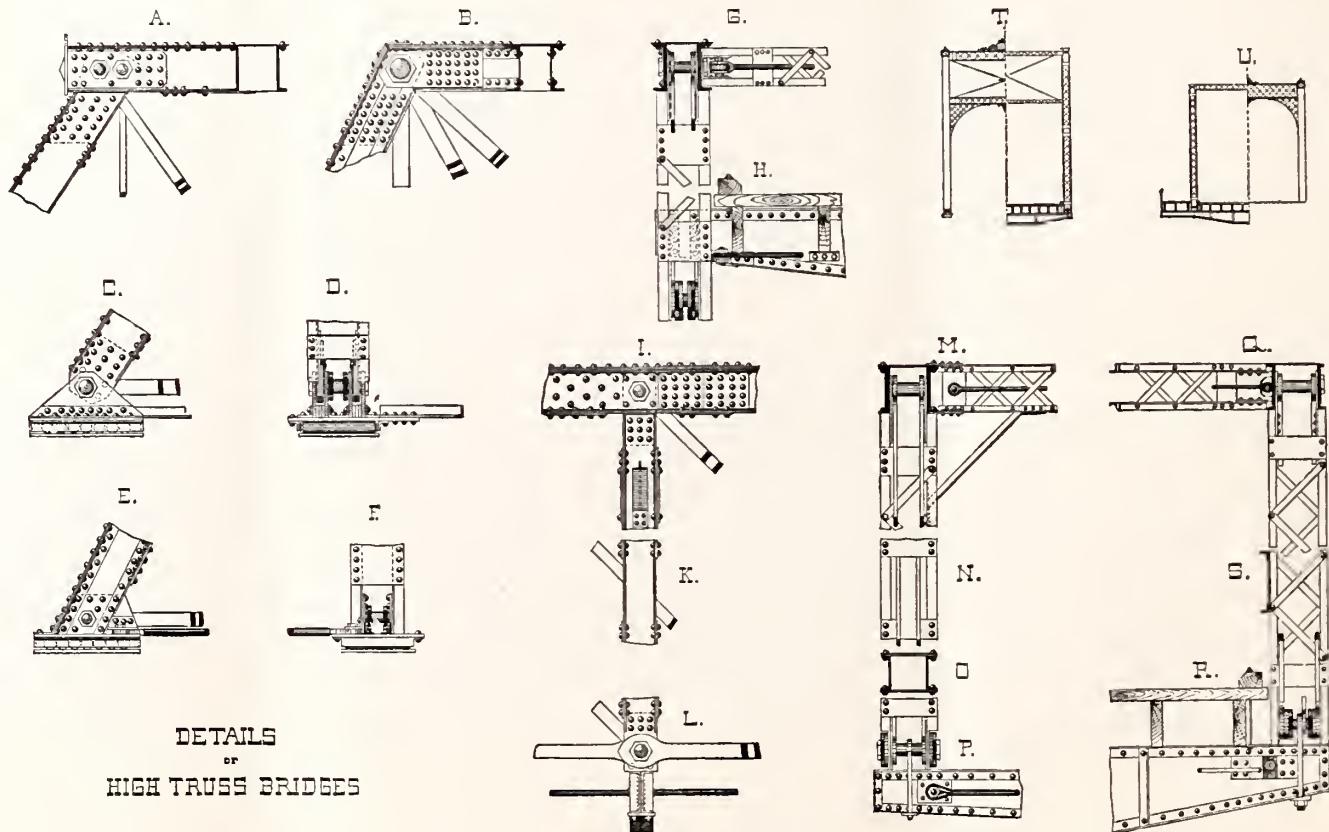
- | | |
|---|---|
| City of Milwaukee, Wis. | Erie County, New York. |
| La Valle, Wisconsin. | Chatauqua County, New York. |
| Two Rivers, Wisconsin. | Red House, New York. |
| Butler County, Iowa. | Newburgh, New York. |
| Peru, Illinois. | Columbiana County, Ohio. |
| Wayne County, Indiana. | Lawrence County, Ohio. |
| Grenada, Mississippi. | Butler County, Ohio. |
| Flint, Michigan. | Pickaway County, Ohio. |
| Eagle, Michigan. | Jefferson County, Ohio. |
| Conway, Massachusetts. | Miami County, Ohio. |
| Limestone County, Alabama. | Carroll County, Ohio. |
| Mercer County, New Jersey. | Mercer County, Pennsylvania. |
| Frederick County, Maryland. | Washington County, Pennsylvania. |
| Cecil County, Maryland. | Westmoreland County, Pennsylvania. |
| Tyler County, West Virginia. | Montgomery County, Pennsylvania. |
| Giles County, Tenn. | Lawrence County, Pennsylvania. |
| Collins County, Texas. | Luzerne County, Pennsylvania. |
| Sherman, Texas. | Butler County, Pennsylvania. |
| Cooke County, Texas. | Elk County, Pennsylvania. |
| Travis County, Texas. | Bridgewater, Penn'a, { 2 Span 200' } 20 ft. Roadway and one
{ 1 " 160' } 5 ft. walk. |
| Cleveland County, North Carolina. | Treichler's, Lehigh County, Pennsylvania. |
| Mason and Cabell Counties, West Virginia. | |



BRIDGE AT SMITH'S FERRY, PA.—SPAN OF 238 FEET. 16 FOOT ROADWAY.
BUILT BY THE PENN BRIDGE CO.



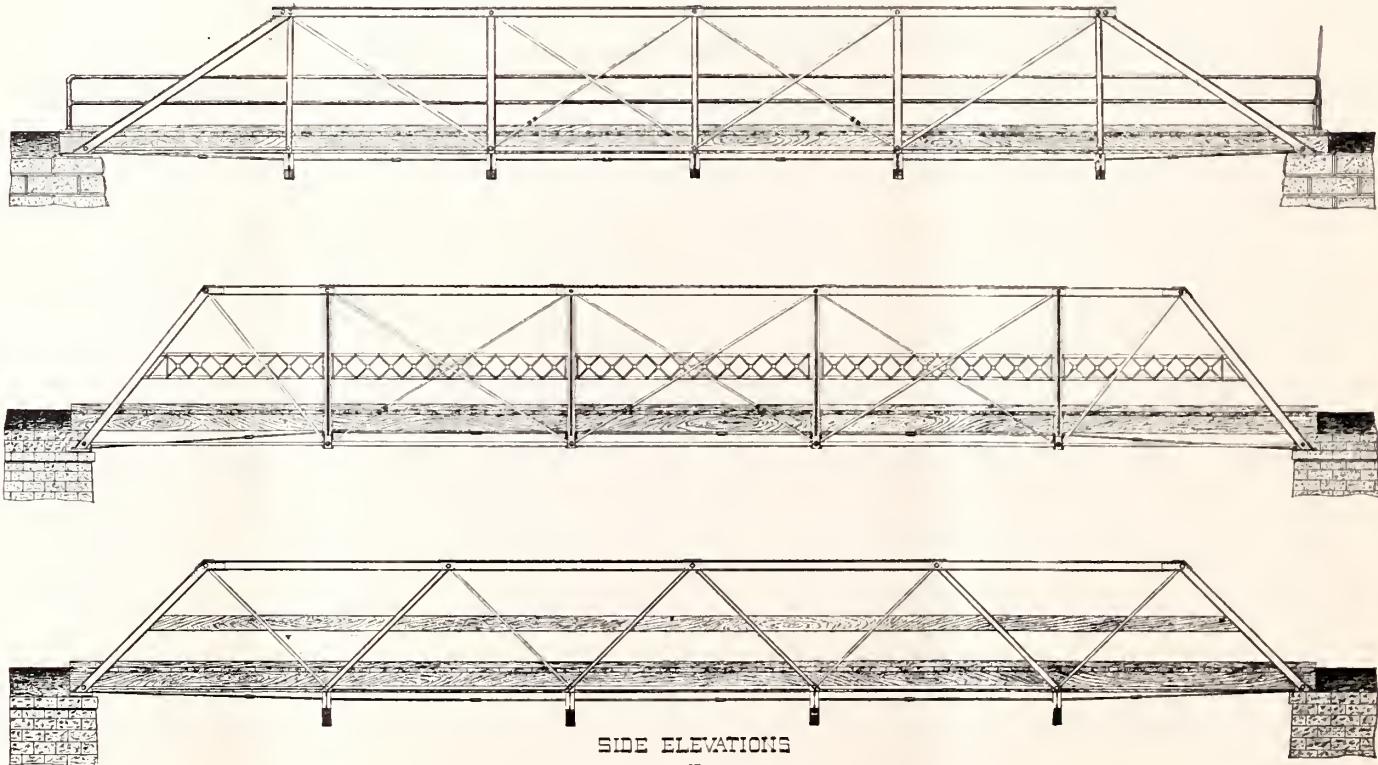
BRIDGE AT NEW GALILEE, PENN.—130 Foot Span, 16 Foot Roadway.
BUILT BY THE PENN BRIDGE CO.



DETAILS
or
HIGH TRUSS BRIDGES

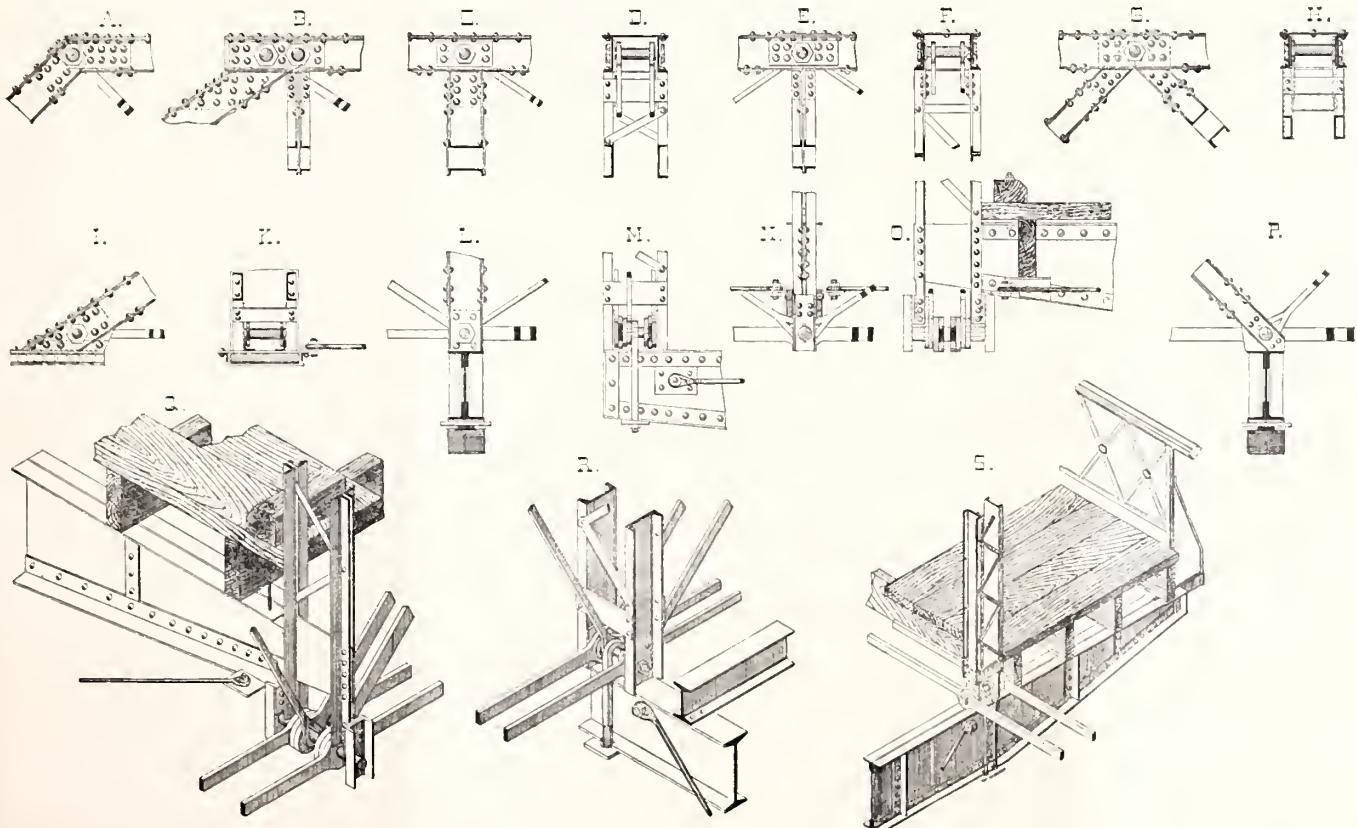
DETAILS OF HIGH TRUSS BRIDGES.

At A and B are shown different designs of hip connections for high truss bridges, and are both good details; that at A however, giving the nearest approach we think practicable to a square or flat bearing. At C and E are elevations of shoes; that at E is the more usual, while that at C gives probably a more evenly distributed pressure of the shoe on the masonry. We have shown on the cross section of shoe at D, a stiff lateral connection made of angle bar; while that at F shows the ordinary adjustable lateral connection made of round iron with a flattened eye; the detail shown on elevation of connection of the lateral to shoe is also used on upper chord and floor beams; other lateral connections for upper chord are shown in the sections at G, M and Q, and for beams at H, P and R. Beams are shown above the chord at H, and suspended at P and R. The posts, we almost always use of two channel bars latticed as shown in section at O; and details in connection with side view of upper chord made of built channel at I; side elevation of post, at center, for double intersection bridge at K, and side view of lower chord at L: also in connection with cross section of upper chord at G, M and Q; and cross sections of lower chord at H, P and R. Knee braces are shown at intermediate posts in details I and M. End elevations with portal bracing and cross sections with and without lower struts, differing for different heights of truss are shown at T and U.



SIDE ELEVATIONS
or
LOW TRUSS BRIDGES

DETAILS of LOW TRUSS BRIDGES



SIDE ELEVATION OF LOW TRUSS BRIDGES.

On page 16 are represented several styles of low truss bridges of our manufacture. The first is the ordinary Whipple Truss; these we built with Latticed Suspenders, to aid in bracing the Truss sidewise; the second is a modification of the first in the inclination of the End Post; the third is the Warren Truss, and is a very economical construction for Low Truss Bridges, and as we have made them, have given very great satisfaction. The inclination of the end post, it will be noticed, is about the same as in the second style usually termed "Low Truss" with half battered End Post. Of the Hub Plank or Guard, we show three styles, viz.; Plank, Iron Lattice and Gas Pipe; either of these can be used on any style of truss, according to choice and cost.

We have Low Truss Bridges in considerable numbers in almost every State east of the Missouri River.

DETAILS OF LOW TRUSS BRIDGES, SHOWN ON PAGE 17.

At A, is shown detail of construction at hip of middle or lower style of bridge on page 16. At B is the detail of similar connection in the first style on same page. I and K represent the Shoe of any of these Bridges. C and L shows side elevation, and D and M Cross Section at same point for a Low Whipple Truss with suspended built floor beam and channel iron post; at S is shown an isometrical view of the same lower chord connection for bridge with sidewalk and handrail; at R the same, with solid rolled I floor beam and joists.

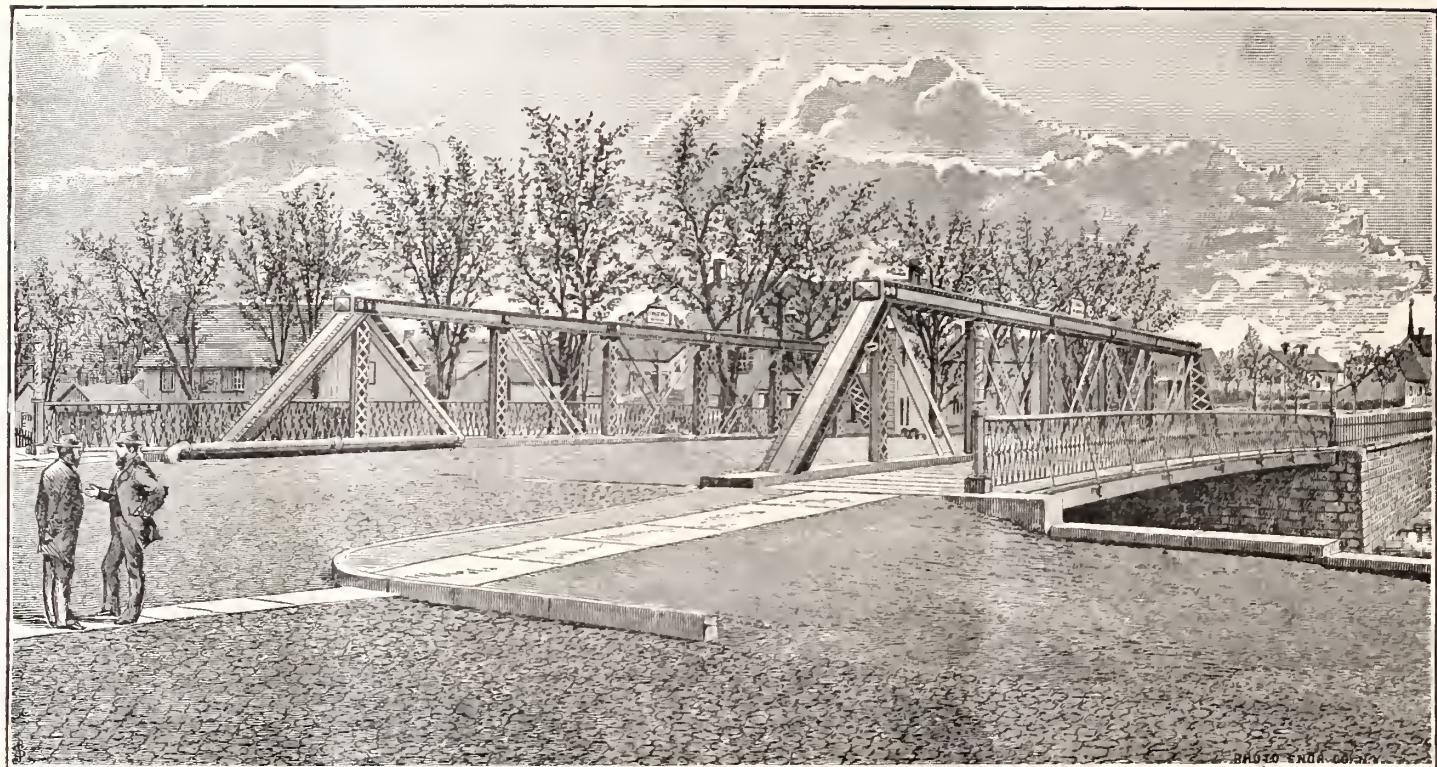
At E and N are shown side elevations, and at F and O cross sections at the same points of upper and lower chords of a low, Whipple Truss Bridge, with angle iron posts, and built beam placed above lower chord; an isometrical view of same is shown at Q.

G, H and P show similar details of the Warren Truss.

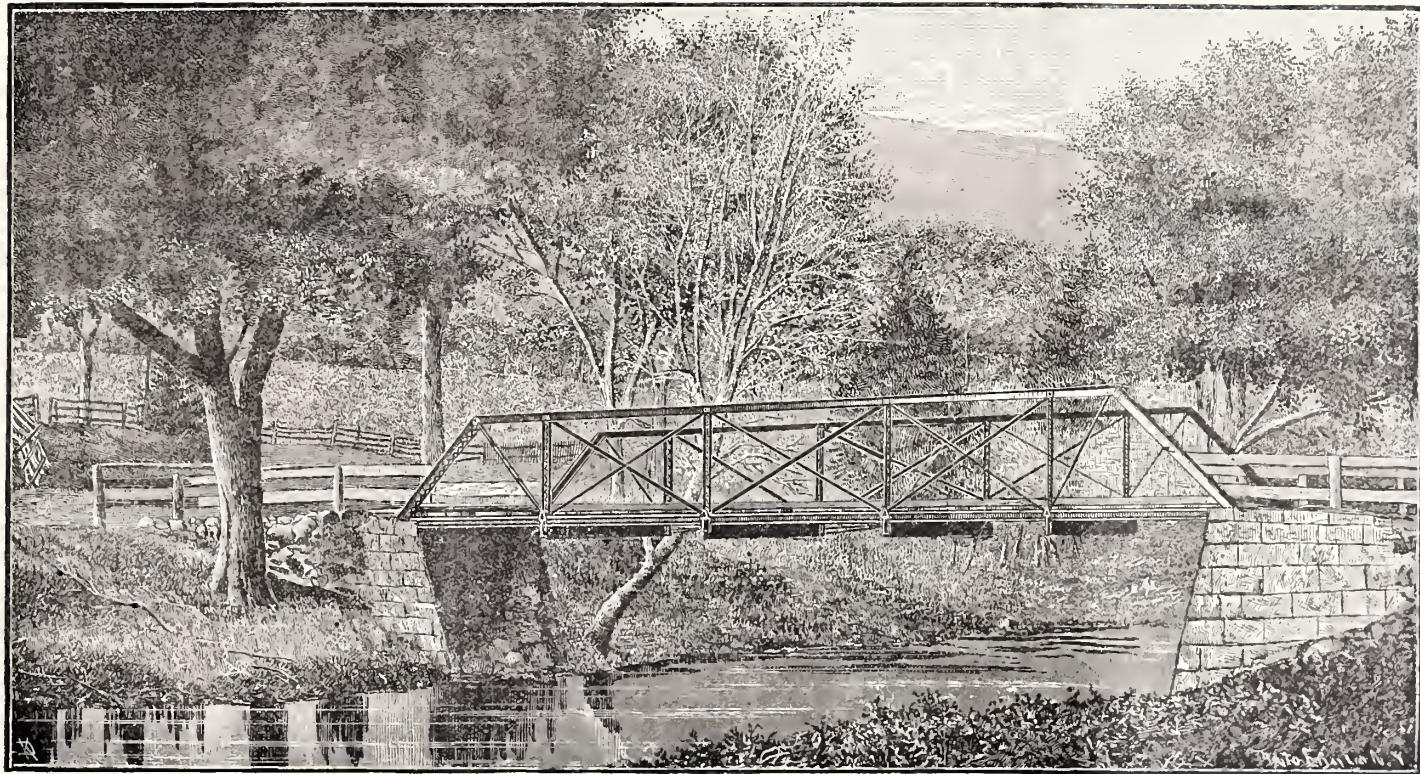
BRIDGE AT CITY OF RAHWAY, NEW JERSEY.

On page 20 is an extreme case of a low truss bridge, erected by us in the City of Rahway, New Jersey. The span is 110 feet with one roadway 36 feet wide in the clear, and two sidewalks each 10 feet wide in the clear, being the longest span and widest single roadway of any low truss which we know of having been built.

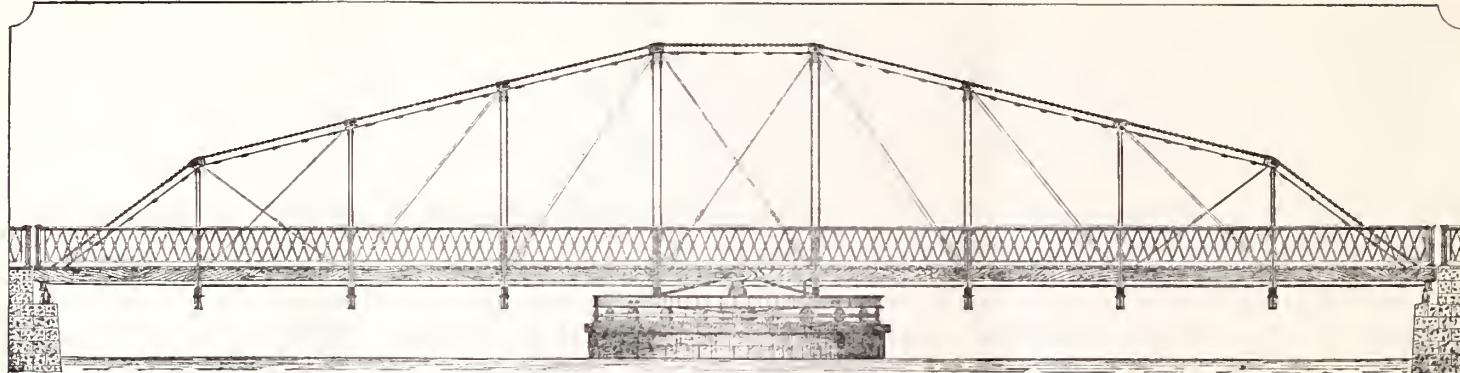
On page 21 is shown an ordinary low truss bridge of 50 feet span.



MONROE STREET BRIDGE.—BUILT BY THE PENN BRIDGE CO.

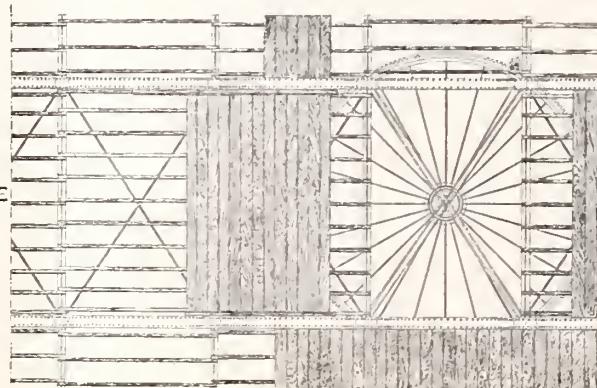


BRIDGE AT PEEKSKILL, N Y.—SPAN 53 FEET, 14 FOOT ROADWAY.
BUILT BY THE PENN BRIDGE CO.

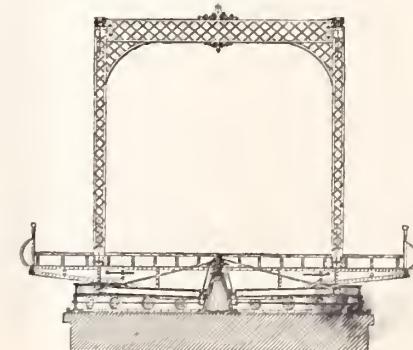


ELEVATION

DESIGN
or A
PRATT TRUSS DRAW BRIDGE



PLAN



CROSS SECTION

DRAW BRIDGES.

In draw bridges, is required the most accurate workmanship of any class of bridge work, as, in addition to their being required to sustain loads under different conditions, ease in turning the bridge can only be maintained by having insured good work when the bridge is new. In addition to the style shown, we also manufacture almost all styles of trusses, both high and low, with parallel chords, for the same purpose.

We would name the following draw-bridges as having been lately built by us.

Span, 140 feet; 18 feet roadway and two 5 feet sidewalks: Milwaukee, Wisconsin.

" 150 " 18 " " " two 7 " " Milwaukee, Wisconsin.

" 120 " 22 " " " two 5 " " Rahway, New Jersey.

" 120 " 12 " " Noxubee County, Mississippi.

" 100 " 16 " " Sheboygan, Wisconsin.

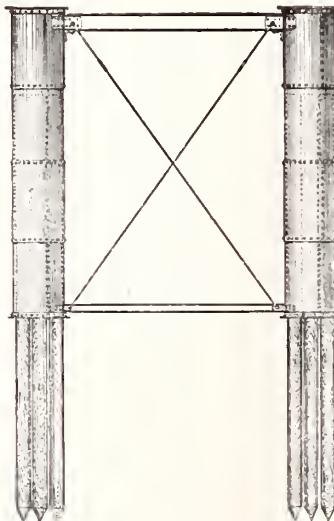


SUSPENSION BRIDGE AT FRANKLIN, OHIO.—SINGLE SPAN OF 365 FEET, 20 FOOT ROADWAY.
BUILT BY J. W. SHIPMAN, ENGINEER.

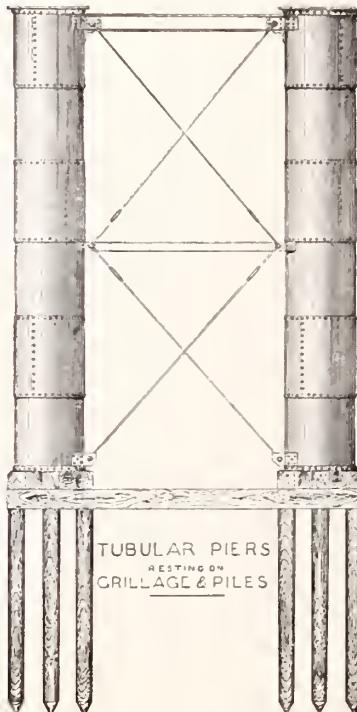
SUSPENSION BRIDGES,

Of which an excellent example is shown on the opposite page, are best adapted of any style for long spans; say from 300 to 1000 feet. When properly constructed these bridges cannot be excelled, and have stood the test of long-continued use. Their economy in cost is greatest, when, for shorter spans, it would require numerous and expensive foundations. This department is in charge of our Eastern agent, J. W. Shipman, C. E., who has devoted to it many years of study. The following successful examples, of his construction, attest the value of his experience:

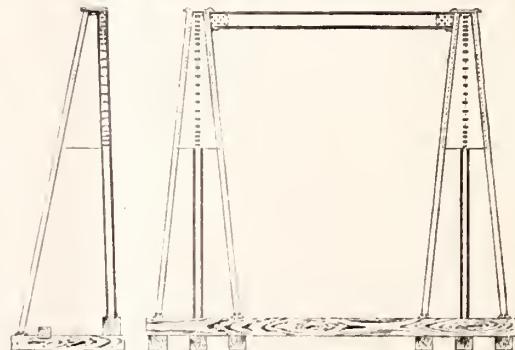
	Bridge at Harrison, Ohio.	Single Span of 420 feet by 18 foot roadway.
	" " Linwood, Ohio.	" " " 350 " " 20 " "
	" " Turner's Falls, Mass.	" " " 550 " " 20 " "
Foot	" " Delaware, Ohio.	" " " 200 " " 6 " "
	" " Charleston, W. Va.	" " " 280 " " 18 " "
	" " Windsor Locks, Conn.	Center Span of 550 feet and two approach spans of 300 feet each, by 20 foot roadway.



TUBULAR PIERS
— FILLED WITH —
PILES & CONCRETE



TUBULAR PIERS
RESTING ON
GRILLAGE & PILES



TRESTLE ABUTMENT

IRON PIERS AND ABUTMENTS

IRON SUB-STRUCTURES.

We are prepared to build any kind of iron sub-structures in localities where masonry is not available, or where they can be built much cheaper than stone work.

The styles most commonly used by us are shown on opposite page.

In addition to the styles of trusses illustrated in this pamphlet, we are prepared to build all styles of Deck Arches, Cantilevers, and all styles of Trusses having upper chords more or less inclined.

We also build Combination Bridges with upper chords and posts of wood; or with wooden chords and iron posts; the details of these bridges are made first-class in every particular. At the date of issuing this catalogue, however, the price of all iron bridges is so low that but very few combination bridges are called for.

We trust that no one at the present day is deterred from building iron bridges in the place of wood by the difference in the cost, as it is now very slight for bridges of equal capacity; and with the growing scarcity of timber, it is likely by the time a wooden bridge would be worn out that it could not be replaced with wood for any less than iron. Therefore, build iron now. We are glad to quote prices at any time. In writing for prices, please give us as much of the following information as possible: number and length of spans; width of roadways and number and width of foot walks; name of nearest Railroad Station and its distance from bridge site; depth of water at low and high stages, and height of floor above water; what class the bridge would come under in our table, and whether in your judgment any stronger bridge is required.

The Penn Bridge Works were first established in 1868, in a small way, and have grown since—so that in the past three years the amount of work turned out amounted to 20,000 lineal feet of single track iron bridges. The total amount built by these works since their start will amount to over ten miles.

Two main lines of railroads (on which we have our own siding) pass through our town, the Pittsburgh, Ft. Wayne & Chicago Railroad (Pennsylvania system) and the Pittsburgh & Lake Erie Railroad (Vanderbilt system). Our works are easily accessible to visitors, whom we always welcome and are glad to show through our establishment and over several fine bridges in the immediate vicinity; they are also admirably situated for convenient access to the principal iron markets of the country, and having natural gas and other special advantages for manufacturing and shipping to all points; in addition to the railroads named, the Ohio River being only three miles distant.

Among other manufactoryes of the Beaver Valley, lying within a range of five miles up and down the river, are large Iron, Steel, Wire, Rivet, Cutlery, File, Axe and Saw Works, several Glass Works of various branches, and numerous Potteries and Brick Works.

We hope to hear from you when you have any bridges to let or in contemplation, and all business intrusted to us will have prompt and careful attention.

Respectfully,

PENN BRIDGE CO.



BRIDGE AT FLINT, MICHIGAN.

SPAN OF 130 FEET.

TWO 16 FT. ROADWAYS.

TWO 8 FT. SIDEWALKS.